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I also certify that the attached copy of the request for grant of a Patent (Form 1/77) bears an amendment, effected by this office, following a request by the applicant and agreed to by the Comptroller-General.

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Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
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1. Your reference — PA 5060

2. Patent application number *(The Patent Office will fill this part in)* — 13 JAN 2004 — 0400665.6

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

   PetroTechnik Limited

   PetroTechnik House
   Olympus Close
   Whitehouse Industrial Estate
   Ipswich, Suffolk IP1 6LN

   Patents ADP number *(if you know it)* — 07490626002

   If the applicant is a corporate body, give the country/state of its incorporation — United Kingdom

4. Title of the invention

5. Name of your agent *(if you have one)* — ~~SOMMERVILLE & RUSHTON~~ Mewburn Ellis

   "Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

   45 Grosvenor Road
   St Albans
   Hertfordshire
   AL1 3AW

   Patents ADP number *(if you know it)* — 1511001

6. Priority: Complete this section if you are declaring priority from one or more earlier patent applications, filed in the last 12 months.

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. Divisionals, etc: Complete this section only if this application is a divisional application or resulted from an entitlement dispute (see note d)

Number of earlier UK application	Date of filing *(day / month / year)*

8. Is a Patents Form 7/77 (Statement of inventorship and of right to grant of a patent) required in support of this request?

   Answer YES if:

   a) any applicant named in part 3 is not an inventor, or
   b) there is an inventor who is not named as an applicant, or
   c) any named applicant is a corporate body.

   Otherwise answer NO (See note d)

Patents Form 1/77

9. Accompanying documents: A patent application must include a description of the invention. Not counting duplicates, please enter the number of pages of each item accompanying this form:

Continuation sheets of this form	0
Description	8
Claim(s)	0
Abstract	0
Drawing(s)	4

10. If you are also filing any of the following, state how many against each item.

Priority documents	0
Translations of priority documents	0
Statement of inventorship and right to grant of a patent (Patents Form 7/77)	0
Request for a preliminary examination and search (Patents Form 9/77)	0
Request for a substantive examination (Patents Form 10/77)	0
Any other documents (please specify)	0

11. I/We request the grant of a patent on the basis of this application.

Signature(s) Sommerville & Rushton Date 13 January 2004

12. Name, daytime telephone number and e-mail address, if any, of person to contact in the United Kingdom

Dr Ian H Coates
01727 854215

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Improved Plastic to Metal Fitting

Field of the Invention

The present invention relates to a method and apparatus for forming a plastics to metal joint in a pipework system. It is particularly applicable, but in no way limited, to a method and apparatus for joining together a pipe made of plastics material and a metal fitting as part of a petroleum pipework system.

Background to the Invention

Pipes made of plastics material are used extensively in industry and in construction. Many applications now use pipes made from plastics materials such as polyethylene and polypropylene rather than metal. One such application is the pipework used in petroleum installations such as garage forecourts.

There is often a need to join pipes made of plastics material to existing or new metal parts, for example metal dispensing pumps or storage tanks.

Whilst every effort is made to avoid having joints in an underground supply pipeline, other than inside manhole chambers, these joints sometimes cannot be avoided. When joining plastic to plastic components, such joints are conventionally made using special fittings and the connections are made using a chemical-based jointing compound or by electrofusion welding. The latter technique is preferred in many applications.

In a conventional plastic piping system, successive lengths of plastic pipe are joined end to end, where necessary, using so-called electrofusion couplings or welding muffs, which typically comprise short plastic sleeves providing sockets at either end having internal diameters of a size to receive the ends of the respective pipes as a close fit and incorporating electrical resistance heating windings. Thus two adjoining pipe lengths can be connected end to end by inserting the adjoining pipe ends into such an electrofusion coupler from opposite ends and thereafter passing electric current through the heating windings in order to fuse the internal surfaces of the electrofusion coupling and the adjoining the external surfaces of the inserted pipe ends, thereby welding the pipe ends to the electrofusion coupling to form a fluid tight joint.

However, when such plastics pipes need to be connected to metal pipework, or other ancillary equipment, couplings known as transition fittings must be used.

Some currently available transition fittings rely on mechanical compression joints to connect, for example, polyethylene pipes to metal pipes and/or fittings. Such transition fittings fall into two general types: fittings which are factory assembled and fittings which are designed to be assembled on site. Of the two, factory assembled fittings are generally preferred as mechanical joints for site assembly tend to be expensive, require the use of special tools, and their effectiveness is often dependent upon the level of skill of the assembler.

In any event, factory assembled fittings leave a polyethylene termination, or tail, which is usually in the form of a plain pipe which must be joined to a polyethylene pipe on site. Thus a further connector, such as a conventional electrofusion coupler, must be used. Presently, two separate couplings, i.e. a termination fitting and an electrofusion coupler, are required to join a single polyethylene pipe to a metal fitting.

GB 2,298,014A (Wask-RMF Limited) describes an elaborate coupling for joining a plastics pipe to metal pipework, or other ancillary equipment, which can be joined to a plastics pipe on site by an electrofusion process without the requirement for a separate electrofusion coupler. This type of fitting uses the body of the metal fitting itself as part of the electrical circuit to conduct current to the heating element.

It uses this arrangement so that both terminals of the heating element may be sited away from the area of the join. This is to avoid the possibility of the heating element providing a leak path through which fluid may egress when the join is subjected to fluid pressure.

It further describes that siting the terminals at the same end of the heating element remote from the join is not acceptable because, during fusion of the coupling and pipe, adjacent opposite polarity windings can touch which reduces the heating effect of the element.

This arrangement, which requires a number of components to complete the internal circuitry necessary to pass electric current through the heating element, is both complicated and costly to construct and unreliable in use. However, it serves to show that there is a general prejudice in this field against a metal to plastics coupling incorporating electrofusion windings having both electrical terminals in the plastics portion of the fitting. The reasons for the current thinking are set out in GB 2,298,014A. As a result the industry has looked to other solutions to the problem of making such joints and generally relies on the use of separate electrofusion couplings.

It is therefore an object of the present invention to overcome or mitigate some or all of the problems outlined above.

Summary of the Invention

According to a first aspect of the invention there is provided a coupling device for use in forming a plastics material to metal joint in a pipeline system, said device comprising:-

(i) a first component comprising substantially of metal;

(ii) a second component comprising substantially of plastics material, the first and second components being joined together in a fluid tight manner, and wherein the second component comprises an open-ended socket adapted to receive a pipeline component;

characterised in that the second component further comprises energy transfer means with electrical terminals located on the second plastic component, said energy transfer means being adapted to cause in use the coupling device and the pipeline component to form a substantially fluid-tight seal therebetween.

In a particularly preferred embodiment the first metal component extends along a portion of the inside of the open socket of the second plastics component.

Preferably the first metal component acts as a heat sink.

Preferably at least one O-ring is used to maintain a substantially fluid tight seal between the first and second components.

Preferably the first metal component engages with a shoulder on the second component to prevent separation of the components in use.

Brief Description of the Drawings

The invention will now be described, by way of example, with reference to the accompanying drawings, wherein:

Figure 1 shows a plan view of a coupling, according to a first embodiment of the present invention, connected to a metal pipe at one end and a plastic pipe at the other;

Figure 2 shows a plan view of the coupling in Figure 1 excluding the pipework components;

Figure 3 shows a plan view of the metal component of the coupling shown in Figure 2;

Figure 4 shows a plan view of the plastic component containing the electrofusion windings of the coupling shown in Figure 2.

Description of the Preferred Embodiment

The present embodiments represent the best ways known to the applicant of putting the invention into practice, but they are not the only ways in which this could be achieved. They are illustrated, and they will now be described, by way of example only.

Figure 1 shows a coupling device according to a first embodiment of the present invention. The coupling device 10 consists of a first substantially metallic component 11 and a second substantially plastics component 12. The two components are joined together during manufacture to form a substantially fluid tight seal there between by methods which are known to those skilled in the art. For example, the plastics components could be integrally moulded onto the metal

component as one operation, or the plastic and metal components could be joined together by a separate swaging operation.

The metal component 11 has an end portion 13 remote from the plastics component 12 which is adapted to receive a threaded metal component. In this example, screw threads 14 are used to engage a threaded metal pipe 15. Alternatively, the end portion 13 could be a flange or indeed any other union to permit the metal component 11 to engage with another component.

The metal should be any fuel resistant metal such as stainless steel and may optionally include linings or coverings which may be formed from metal or from a plastics material, as selected by the materials specialist.

The plastics component 12 defines an open ended cylindrical socket for receiving the end of a plastic pipe 18 to which the coupling engages in use. The inner surface 24 of the second component 12 accommodates windings 16 of electrical heating wire which lie close to, or at, the internal surface of the plastics component 12. These windings are electrically connected to terminal pins 17 projecting from the plastics component 12. The terminal pins 17 can be shrouded by hollow cylindrical plastic terminal shrouds (not shown) projecting from, and integral with, the plastic component 12. For the purposes of this description the term pipe generally refers to a circular cross-sectioned pipe. However, this invention also covers other cross sections such as box sections, corrugated and the like and also single walled or secondarily contained pipes.

The plastic component 12 is designed so that in engages tightly with the plastics pipe 18. In use, application of electric current to the terminals 17 causes the windings to heat up and fuse the surface of the plastics component 24 with the pipe 18. The material selected for at least the internal surface region of the plastics component 12 should comprise a fusible material which, when heated via the energy transfer means, at least partially melts, causing the plastics component and the plastic pipe to fuse together.

The term "fusible material" has a very broad meaning in this context. It is intended to encompass any polymeric material which, when energy is applied to it, can melt and fuse together with an adjacent material and is also intended to additionally

cover thermosetting adhesives and resins. Ideally a thermoplastic such as polyethylene can be used.

An advantage of the present invention is that the two components of this fitting can be manufactured using existing techniques, and require no special apparatus.

In a further important feature of the present invention, a portion 20 of the metal component 11 extends along the inside bore of the open socket of the second plastics component 12. This strengthens the joint between the metal and plastic components. An outwardly extending flange or hook 22 of the extended portion 20 engages with a shoulder or step 23 on the plastics component 12 to prevent lateral or axial movement of the plastics component once the joint between them has been made and provides greater strength and stability once the two components are joined together. The metal component 11 can be slotted radially or longitudinally to resist any movement of the plastic component 12.

The extended portion 20 has the additional advantage that it could allow the metal component 11 to act as a heat sink when the electrical heating wire 16 is fusing the plastics component 12. Because of the compact size of the coupling, the energy transfer means is located relatively close to the joint between the metal 19 and plastic 21 components. Because the metal and plastic components have different specific heat capacities and expansion rates, heating this joint region could result in the fluid tight seal being broken as the plastics material moves away from the metallic component. The extending portion 20 helps the heat to be drawn away from the sensitive region in which the two components are joined and away from any electrical terminal(s) which may be in that part of the fitting.

The join can additionally be made substantially fluid tight by the use of one or more internal O-rings or other sealing member.

Figure 2 shows the coupling device without the pipework components it would join together. Figure 3 shows an isolated view of the metal component and figure 4 shows an isolated view of the plastics component.

Preferably the second plastic component is formed from one or more plastics materials selected from the group comprising:-

polyethylene;
polypropylene;
polyvinyl chloride;
polybutylene
polyurethanes;
polyamides, including polyamides 6, 6.6, 6.10, 6.12, 11 and 12;
polyethylene terphthalate;
polybutylene terephthalate;
polyphenylene sulphide;
polyoxymethylene (acetal);
ethylene/vinyl alcohol copolymers;
polyvinylidene fluoride (PVDF) and copolymers;
polyvinyl fluoride (PVF);
tetrafluoroethylene-ethylene copolymer (ETFE);
tetrafluoroethylene-hexafluroethylene copolymers (FEP)
ethylene tetrafluoroethylene hexafluropropylene terpolymers (EFEP)
terpolymers of tetrafluoroethylene, hexafluoropropylene and vinylidene fluoride (THV);
polyhexafluoropropylene;
polytetrafluoroethylene (PTFE);
polychlorotrifluoroethylene;
polychlorotrifluoroethylene (PCTFE);
fluorinated polyethylene;
fluorinated polypropylene;

and blends and co-polymers thereof.

This selection is not intended to be limiting but rather demonstrates the flexibility and breadth of the invention. The plastics material which is most compatible to the pipe to which it will be joined and with the lowest permeability to the fluid in question will usually be chosen by the materials specialist. Furthermore, it is known to use blends of two or more polymers and this invention extends to cover known and yet to be developed blends of plastics material.

Alternatively the plastic component can be formed from 2 or more layers including but not limited to a barrier layer or layers. This form of construction may require the use of one or more tie or adhesive layer between adjacent layers. Alternatively

direct bonding may be used to adhere the individual layers, preferably during melt processing, whereby one or both of the materials have been chemically modified to bond to the other. Additionally, the plastics material or barrier layer(s) may incorporate a dispersed electrically conductive material producing a maximum surface resistivity of 10^6 Ω/sq. This avoids build up of potentially dangerous static electrical charges. A surface resistivity in the range of 10^2 to10^6 Ω/sq is preferred, with a more preferred surface resistivity in the range 10^2 to10^5 Ω/sq Examples of possible barrier layers include:

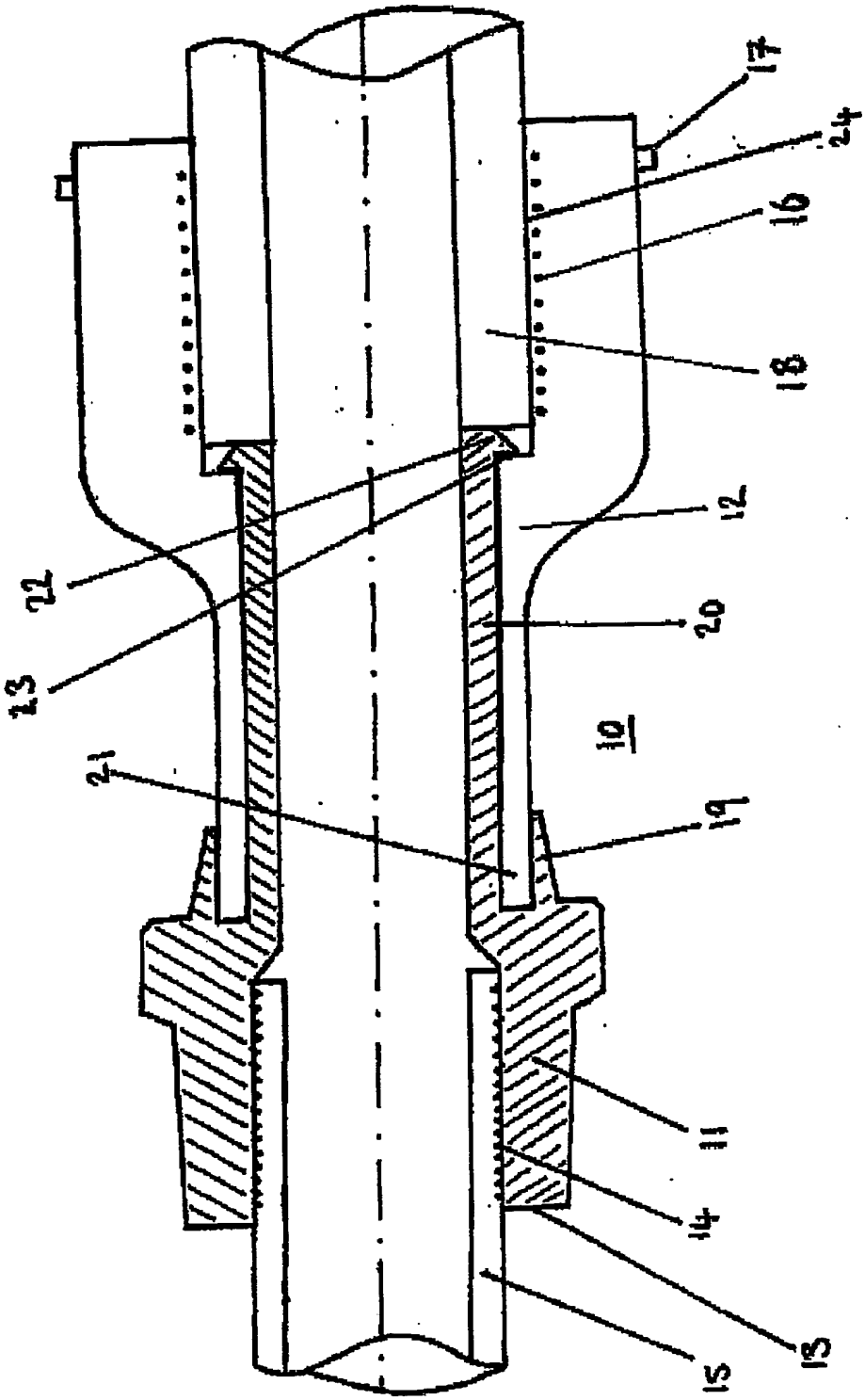
polyvinylidene fluoride (PVDF) and copolymers;
polyvinyl fluoride (PVF);
tetrafluoroethylene-ethylene copolymer (ETFE);
tetrafluoroethylene-hexafluroethylene copolymers (FEP)
ethylene tetrafluoroethylene hexafluropropylene terpolymers (EFEP)
terpolymers of tetrafluoroethylene, hexafluoropropylene and vinylidene fluoride (THV);
polyhexafluoropropylene;
polytetrafluoroethylene (PTFE);
polychlorotrifluoroethylene;
polychlorotrifluoroethylene (PCTFE);
fluorinated polyethylene;
fluorinated polypropylene,

and blends and co-polymers thereof.

Once again, this selection is not intended to be limiting, but rather demonstrates the wide range of polymers that may be used for this purpose. It is intended that this disclosure encompasses all known fluoropolymers providing a suitable barrier function and those yet to be discovered.

1/4

Fig 1



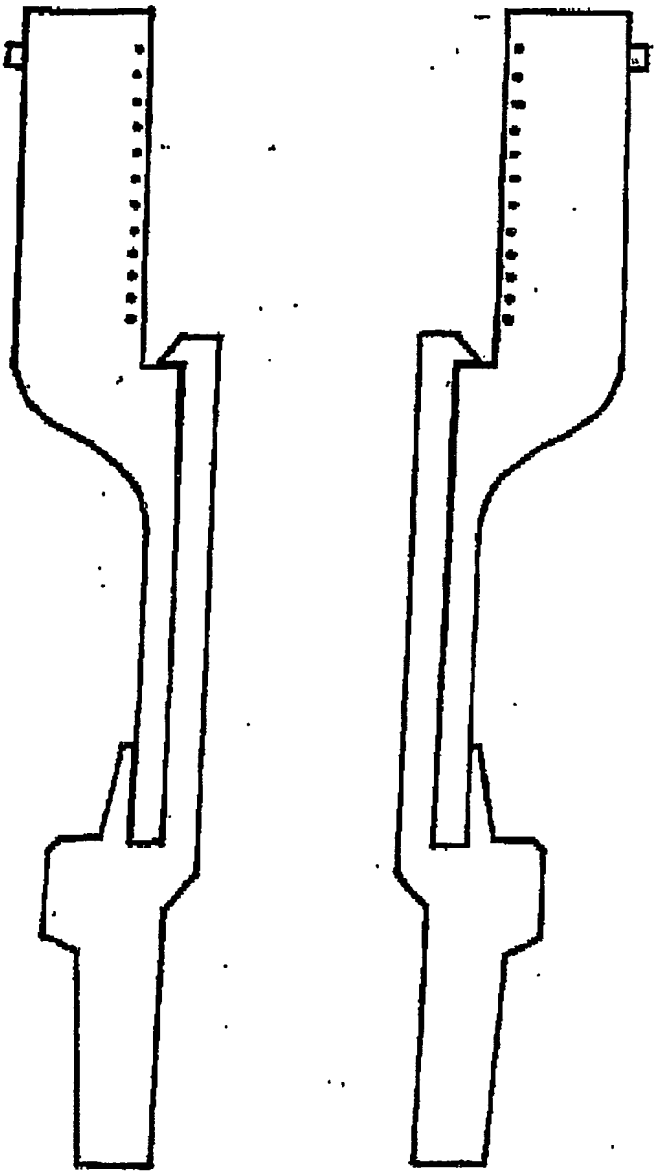
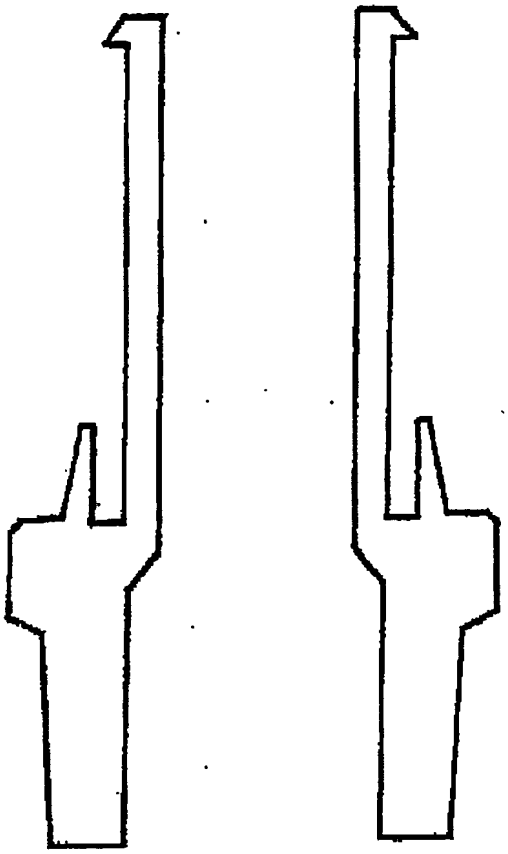


Fig 1

Fig 3



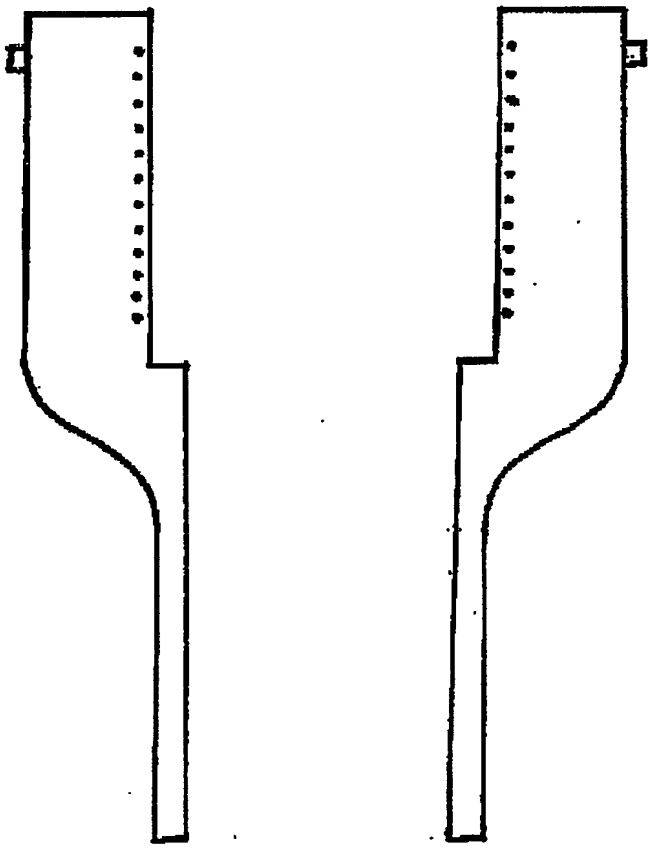


Fig 4

Document made available under the Patent Cooperation Treaty (PCT)

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